REMARKS

Claims 1-30 and 41-46 are pending. Claims 1 and 4 have been amended to even further clarify the claimed subject matter. Claims 1-9, 41 and 45 are in independent form.

Claims 1-31 and 41-46 were rejected under 35 U.S.C. 103(a) as being unpatentable over the publication by *Lau et al.,* entitled "Field Emission from Metal-Containing Amorphous Carbon Composite Films", Diamond and Related Materials, Vol. 10, pp. 1727-1731, hereinafter "*Lau*", in view of International Publication No. WO 99/28939 (*Tuck et al.*), hereinafter "*Tuck*".

Independent Claim 1

As amended, Claim 1 recites:

> 1. An electron-emitting device comprising:
> a cathode electrode;
> a layer electrically connected to the cathode electrode; and
> a plurality of particles, each comprising as a main component a material which has resistivity lower than resistivity of a material of the layer, wherein
> the plurality of particles are arranged in the layer, and
> a density of the particles in the layer is 1×10^{14} particles/cm^3 or more and 5×10^{18} particles/cm^3 or less.

Lau discloses an amorphous carbon layer containing Co. However, *Lau* is seen to be completely silent as to whether the Co contained in the amorphous carbon layer is granulated or not.

Tuck discloses at page 7, lines 3-8, that "the thickness of said insulating material may be in the range 10 nm to 100 nm (100Å to 1000 Å) and said particle dimension in the range 1μm to 10μm", and "[t]here may be provided a substantially single layer of said conductive particles each having their dimension substantially normal to the surface in the range 0.1μm to 400μm." *Tuck* also discloses at page 10, lines 3-6 that

"[s]aid sites [electron emission sites] may be distributed over the field electron emission material at an average density of at least10^2 cm^{-2}", and [s]aid sites may be distributed over the field electron emission material at an average density of at least 10^3 cm^{-2}, 10^4 cm^{-2} or 10^5 cm^{-2}." (Emphasis added).

Thus, *Tuck* discloses the number of electron emission sites per unit area "cm^{-2}", but fails to disclose or suggest the number of electron emission sites per volume "cm^{-3}", as set forth in Claim 1. (Emphasis added).

Nothing in *Lau* or *Tuck* teaches or suggests at least the last paragraph of Claim 1. Accordingly, Claim 1 is believed to be clearly patentable over those references, whether considered separately or in combination.

Independent Claims 2 and 3

Claim 2 recites as follows:

> 2. An electron-emitting device comprising:
> a cathode electrode;
> a layer electrically connected to the cathode electrode; and
> a plurality of particles, each comprising as a main component a material, which has resistivity lower than resistivity of a material of the layer, wherein
> the plurality of particles are arranged in the layer, and
> a concentration of a main element of the particles with respect to a main element of the layer is 0.001 atm% or more and 1.5 atm% or less.

According to an aspect of the present invention to which Claim 2 relates, by controlling a concentration of particles in the layer, the particles are aligned in a thickness direction of the film thickness of the layer. As a result, an excellent electron emission performance can be provided (*see, e.g.*, page 23, line 6 to page 27, line 2.).

As described above, *Lau* is silent as to whether Co contained in the amorphous carbon layer is granulated or not. Moreover, *Tuck* discloses the number of

electron emission sites per unit area in units of "cm^{-2}", but fails to disclose or suggest the number of electron emission sites atomic percentage of the particles "atm%" as defined in Claim 2.

Indeed, nothing in either *Lau* or *Tuck* would teach at least the last paragraph of Claim 2. Accordingly, Claim 2 is believed to be clearly patentable over those references, whether considered separately or in combination.

Independent Claim 3 recites features similar to those of Claim 2 emphasized above, and is believed to be clearly patentable over *Lau* and *Tuck* for the same reasons as is Claim 2.

Independent Claim 5, 6, 7, and 41

Independent Claim 5 recites:

5. An electron-emitting device comprising:
a cathode electrode; and
a layer connected to the cathode electrode, wherein
a plurality of groups of particles, each group being constituted by at least two particles adjacent to each other, are arranged in the layer,
each of the particles comprises as a main component a material which has resistivity lower than resistivity of a material of the layer,
the adjacent two particles are arranged in a range of 5 nm or less,
one of the adjacent two particles is arranged to be nearer to the cathode electrode than the other particle, and
the plurality of groups of particles are arranged apart from each other by a distance equal to an average film thickness of the layer or more.

As described above, *Lau* is silent as to whether Co contained in the amorphous carbon layer is granulated or not.

Tuck, as pointed above, discloses the number of electron emission sites per unit area in units of "cm^{-2}", but fails to disclose or suggest that a "plurality of groups of particles are arranged apart from each other by a distance equal to an average film

thickness of the layer or more", and "adjacent two particles are arranged in a range of 5 nm or less", as set forth in Claim 5.

Accordingly, Claim 5 is believed to be clearly patentable over those references, whether considered separately or in combination.

Like Claim 5, independent Claim 6 recites that "adjacent two particles are arranged in a range of 5 nm or less", and thus Claim 6 also is believed to be clearly patentable over *Lau* and *Tuck*, whether considered separately or in combination, because neither reference is seen to teach or suggest those features.

Also like Claim 5, independent Claim 7 recites that "the plurality of groups of particles are arranged apart from each other by a distance equal to an average film thickness of the layer or more", and thus Claim 7 also is believed to be clearly patentable over *Lau* and *Tuck*, whether considered separately or in combination, because neither reference is seen to teach or suggest those features.

Independent Claim 41 recites features that are similar in many relevant respects to those of Claim 5 emphasized above relating to adjacent particles, and also is believed to be clearly patentable over *Lau* and *Tuck* for the same reasons as is Claim 5.

Independent Claim 8

Independent Claim 8 recites as follows:

> 8. An electron-emitting device comprising:
> a cathode electrode; and
> a layer which is connected to the cathode electrode and comprises carbon as a main component, wherein
> a plurality of groups of particles constituted by at least two particles, which comprise metal as a main component, being adjacent to each other are arranged in the layer,
> one of the adjacent two particles is arranged on the cathode electrode than the other particle, and

graphene is included between adjacent particles among at least part of the plurality of particles.

According to an aspect of the invention to which Claim 8 relates, as described at page 21, lines 12-27 of the specification, by virtue of the existence of a graphene between particles, an excellent performance of the electron emission can be provided. Such an advantage cannot be provided by *Tuck* and *Lau.*

Again, as described above, *Lau* is silent as to a quantity of hydrogen contained in the amorphous carbon layer and also as to a distance between Co particles contained in the amorphous carbon. Moreover, *Tuck* discloses a number of the electron-emission sites per unit area "cm^{-2}", but fails to disclose or suggest an existence of a graphene between the particles as defined in Claim 8.

For these reasons, Claim 8 is deemed clearly patentable over those references, whether considered separately or in combination.

Independent Claims 4, 9, and 45

Independent Claim 9 recites as follows:

9. An electron-emitting device comprising:
a cathode electrode;
a layer which is electrically connected to the cathode electrode and comprises carbon as a main component; and
a plurality of conductive particles arranged in the layer, each particle comprising carbon as a main component, wherein
the layer comprising carbon as a main component contains a hydrogen element of 0.1 atm% or more with respect to a carbon element.

By virtue of the hydrogen quantity defined in Claim 9, an advantage of stress reduction can be provided (*see, e.g.,* page 30, line 7 through page 31, line 4 of the specification).

Again, *Lau* is silent as to a quantity of hydrogen contained in the amorphous carbon layer and also as to a distance between Co particles contained in the amorphous carbon. *Tuck*, as pointed above, discloses the number of electron emission sites per unit area in units of "cm^{-2}". Neither reference is understood to teach or suggest at least the last paragraph of Claim 9, and the Office Action is not seen to provide a persuasive reason that a hydrogen quantity as defined therein would have been obvious. Thus, the advantage achieved by the subject matter of Claim 9 cannot be provided by *Tuck* and *Lau*.

For these reasons, Claim 9 is deemed clearly patentable over those references, whether considered separately or in combination.

Independent Claim 45 recites, in part, that the layer containing carbon as a main component contains hydrogen of 0.1-20 atm% at a ratio to the carbon. For similar reasons as those given above for Claim 9, neither *Tuck* nor *Lau* is seen to teach or suggest those features. Accordingly, Claim 45 is believed to be clearly patentable over *Lau* and *Tuck*, whether considered separately or in combination.

Independent Claim 4 recites features that are similar in many relevant respects to those of Claim 9 discussed above, and also is believed to be clearly patentable over *Lau* and *Tuck*, whether considered separately or in combination, for the same reasons as is Claim 9.

The other claims depend from one or another of the independent claims discussed above, and also are believed to be clearly patentable over the references relied on in the Office Action for the same reasons as are those respective independent claims. Since each dependent claim is also deemed to recite an additional aspect of the invention, however, the individual reconsideration of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request early and favorable consideration and passage to issue of this application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

Respectfully submitted,

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